



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No. : 10/790,093  
Applicant : Robert S. WINSOR  
Filed : March 2, 2004  
TC/A.U. : 2633  
Examiner : Quan-Zhen Wang  
Confirmation No. : 1178  
Docket No. : 0918.0269C  
Customer No. : 27896  
Title : Method and Apparatus for Free Space Optical  
Communication Using Incoherent Light

Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**DECLARATION UNDER 37 CFR 1.132 OF WILLIAM RABINOVICH**

Sir:

I, William Rabinovich, state as follows:

1. I am currently head of the Photonic Materials and devices section of the US Naval Research Laboratory.
2. I have a B.S. Physics degree from the State University of New York, Stony Brook, and M.S. and Ph.D. degrees in Physics from Brown University.
3. Attached as Exhibit A is my resume.
4. I have been involved in research in the areas of optical communications including free space optical communication (FSOC) for eight years and have published numerous papers in this area.
5. I am making the statements herein not as a representative of the U.S. Government or any of its agencies, but only as researcher with knowledge and experience in the field of free space optical communications.
6. Mr. Robert Winsor has described to me the concept of reducing atmospheric scintillation associated with free-space optical

communication (FSOC) by using a beam of phase incoherent light from a single incoherent light source, such as a superluminescent LED (SLED).

7. I am very familiar with SLED devices and their capabilities, and I work in the field of FSOC.
8. Prior to my discussions with Mr. Winsor concerning his idea related to atmospheric scintillation reducing techniques outlined in item 6 above, it did not occur to me that a device, such as a SLED, which produces phase incoherent light, would reduce atmospheric scintillation associated with FSOC. There are many possible factors that contribute to scintillation and only some of them might occur due to temporal coherence. A detailed understanding of what causes scintillation is still an area of active research. As a result, the effects of reducing temporal coherence have, to my knowledge, not been predicted.
9. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

William Rabinovich

Signature: 

Date: 7/25/06



EXHIBIT A  
Curriculum Vitae

William S. Rabinovich

**Education**      Ph.D. - Brown University  
Physics, May 1987  
Thesis Advisor: Professor Nabil Lawandy  
Dissertation: "Distributed Feedback Effects in Lasers and High Gain Laser Instabilities in Optically Pumped CH<sub>3</sub>F"

M.S. - Brown University  
Physics, 1984

B. S. - State University of New York at Stony Brook  
Physics (with high honors), 1982

**Honors**

- NRL Technology Transfer Award 2004
- Federal government outstanding performance award, 1998
- Federal government outstanding performance award, 1994
- Sigma Xi research award, 1987
- Phi Beta Kappa, 1982
- Sigma Pi Sigma, 1982

**Appointments**

- Optical science division representative to the NRL patent review board (1994- 1996)

**Fellowships**

- National Research Council Postdoctoral Fellowship  
at the Naval Research Laboratory, 1987-1989
- NASA Graduate Student Research Fellow, 1985-1987
- Air Force Graduate Student Summer Support Program

**Professional Experience**

Head, Photonic Materials and Devices Section, Optical Science Division, US Naval Research Laboratory, Washington, DC (2000-date)

Research Physicist, US Naval Research Laboratory, Optical Science Division, (1989-2000),  
Research in multiple quantum well spatial light modulators, photorefractive materials, optical pattern recognition, optical phase conjugation, mid-infrared nonlinear optics of quantum well intersubband transitions and free space optical communications.

Contractor, University of South Florida (1989), contractor in the Laser Physics Branch at the Naval Research Laboratory. Research in solid state lasers and achromatic phase conjugation.

Postdoctoral Research Associate, Naval Research Laboratory (1987-1989). Research in distributed feedback lasers, solid state lasers and stimulated Brillouin scattering.

Research Assistant, Brown University (1983-1987) Laboratory of Professor Nabil Lawandy, Division of Engineering and Department of Physics, research in optical bistability, laser instabilities and distributed feedback lasers.

Teaching Assistant, Brown University (1982-1984)  
Department of Physics. Ran physics department computer resource center and taught astronomy laboratory and undergraduate electricity and magnetism help session.

Undergraduate Research Assistant, SUNY Stony Brook (1980-1982), in the lab of Professor Harold Metcalf, research in atomic and molecular physics.

### **Research Interests**

- Free space optical communications
- Micromachining and micro-electromechanical systems
- Nonlinear optics
- Photorefractive materials
- Optical processing and phase conjugation
- Multiple quantum well spatial light modulators
- Mid-infrared nonlinear optics of intersubband transitions

### Selected Publications

- N. M. Lawandy and W. S. Rabinovich, "Absorptive Bistability in a Three Level System Interacting with Two Fields", IEEE Journal of Quantum Electronics, 20 (5), p. 458-460, (1984).
- N. M. Lawandy, W. S. Rabinovich and R. P. Willner, "Laser Induced Diffusion by Collisional Redirection of Molecules", Phys. Rev. A., Vol. 31, No. 3, p. 1419-1422, (1985).
- N. M. Lawandy, D. L. Macfarlane, W. S. Rabinovich and D. H. Katayama, "Two Photon Optical Hysteresis at 1.06  $\mu\text{m}$  in a Nonlinear Fabry-Perot Etalon Containing Rhodamine 6G:Methanol Solutions", Infrared Physics, Vol. 25, No. 6, pp. 755-759, 1985.
- W. S. Rabinovich, Charles A. Adler and N. M. Lawandy, "Self-pulsing and Bichromatic Emission in Homogeneously Broadened Lasers ", Applied Physics B, vol. 44, no. 12, pp. 479-487, December 1987.
- W. S. Rabinovich and N. M. Lawandy, "Coupled Lorenz Systems in an Optically Pumped CH<sub>3</sub>F Laser", Physical Review A, vol. 36, no. 7, pp. 3253-3258, October 1987.
- W. S. Rabinovich and B. J. Feldman, "Spatial Hole Burning Effects in Distributed Feedback Lasers", IEEE Journal of Quantum Electronics, vol. QE-25, no.1, January 1989.
- W. S. Rabinovich, S. R. Bowman, G. Beadie, J. E. Tucker, D. S. Katzer, J. Muth, C. L. Adler, Bradley R. Stone, K. Ikossi-Anastasiou "Multiple quantum well based optical correlator with tunable nonlinear response", Topics in Optics and Photonics: Spatial Light Modulators, Geoffrey Burdge, ed., (Optical Society of America, Washington, DC 1997)
- W. S. Rabinovich, M. Baskansky, S. R. Bowman, R. Mahon, P. Battle, "Speckle photography using optically addressed multiple quantum well spatial light modulators", Optics Express May 1998
- G. C. Gilbreath, W. S. Rabinovich, R. Mahon, D. S. Katzer, K. Ikossi-Anastasiou, M. R. Corson, J. F. Kline, J. H. , H. C. Merk, M. J. Vilcheck, "Modulating retroreflector architecture using multiple quantum wells for free space optical communications", in *International Conference on Applications of Photonic Technology III: Closing the Gap between Theory, Development, and Applications*, George A. Lampropoulos; Roger A. Lessard, Proc. SPIE **3491**, p. 581-586, 1998
- W. S. Rabinovich, G. C. Gilbreath, P. G. Goetz, R. Mahon, D. S. Katzer, K., Ikossi-Anastasiou, S. Binari, T. J. Meehan, M. Ferraro, I. Sokolsky, J. A. Vasquez, M. J. Vilcheck, "InGaAs Multiple Quantum Well Modulating Retro-reflector for Free Space Optical Communications," in *Free Space Laser Communication and Laser Imaging*, David G. Voelz and Jennifer C. Ricklin, editors, Proceedings of the SPIE Vol. 4489, pp. 190-201
- N. G. Creamer, G. C. Gilbreath, T. J. Meehan, M. J. Vilcheck, J. A. Vasquez, W. S. Rabinovich, and P. G. Goetz, "Interspacecraft Optical Communication and Navigation Using Modulating Retroreflectors," Journal of Guidance Control and Dynamics, 27(1), 100-106 (2004).
- W. S. Rabinovich, R. Mahon, H. R. Burris, G. C. Gilbreath, P. G. Goetz, C. I. Moore, M. F. Stell, M. J. Vilcheck, J. L. Witkowski, L. Swingen, M. R. Suite, E. Oh, J. Koplow, " Free-space optical communications link at 1550 nm using multiple quantum well modulating retro-reflectors in a marine environment", Opt. Eng., 44(5), (2005)

### **Selected Conference Presentations**

W. S. Rabinovich and N. M. Lawandy, "Modes and Dynamics of Distributed Feedback Media in Partially Filled Ring Cavities", 1987 International Quantum Electronics Conference, JOSA B, vol 4, no. 8 pt. 2, pp.88, August 1987.

W. S. Rabinovich and B. J. Feldman, "Phase Conjugate Distributed Feedback Lasers", Quantum Electronics and Laser Science Conference 1989 Technical Digest Series, vol. 12, WDD37, May 1989.

W. S. Rabinovich, M. Bashkansky, S. R. Bowman, R. Mahon, P. Battle, "Laser speckle photography with optically addressed multiple-quantum well spatial light modulators", Conference on Lasers and Electro-optics, vol. 6, 1998, OSA technical digest series, p. 402.

G. Charmaine Gilbreath, William S. Rabinovich, Rita Mahon, Michael R. Corson, John F. Kline, Joshua Resnick, H. Charles Merk, and Michael J. Vilcheck, "Modulating Retroreflector Architecture using Multiple Quantum Wells for Free Space Optical Communications", ICAPT meeting, March 1999

W. S. Rabinovich, G. C. Gilbreath, R. Mahon, D. S. Katzer, K. Ikossi-Anastasiou, "Optimization of multiple quantum well modulating retro-reflectors for free-space optical communication", OSA annual meeting October 2000, Providence, RI.

William S. Rabinovich, Peter G. Goetz, Rita Mahon, Eugene Waluschka, D. S. Katzer, Steven C. Binari, Mark L. Biermann, and G. C. Gilbreath, "Cat's eye quantum well modulating retroreflectors for free-space optical communications," Proceedings of SPIE, Free-Space Laser Communication Technologies XV, G. Stephen Mecherle, ed., v 4795 pp. 92-102, July 2003.

Goetz, P. G., Mahon, R., Stievater, T. H., Rabinovich, W. S., and Binari, S. C., "High-Speed Large Area Surface-Normal Multiple Quantum well Modulators," in Free-Space Laser Communication and Active Laser Illumination III, held in San Diego, CA, 04-06 AUG, 2003, edited by Voelz, D. G. and Ricklin, J. C. Bellingham, WA: SPIE - The International Society for Optical Engineering, 2004.

Moore, C. I., Burris, H. R., Suite, M. R., Stell, M. F., Vilcheck, M. J., Davis, M. A., Mahon, R., Rabinovich, W. S., Gilbreath, G. C., Oh, E., Scharpf, W. J., and Reed, A. E., "Spatial Intensity Correlation and Aperture Averaging Measurements in a 20 Mile Retro-Reflected Lasercom Link," in Free-Space Laser Communication and Active Laser Illumination III, held in San Diego, CA, 04-06 AUG, 2003, edited by Voelz, D. G. and Ricklin, J. C. Bellingham, WA: SPIE - The International Society for Optical Engineering, 2004.

### **Invited Presentations**

W. S. Rabinovich, C. G. Gilbreath and B. J. Feldman, Photorefractive Noise Suppression using Achromatic Gratings, Topical Meeting On Photorefractive Materials 1991

W. S. Rabinovich, "Multiple Quantum Well Spatial Light Modulators", Invited colloquium, University of Arkansas at Fayetteville, April 1994

W. S. Rabinovich, "Optical processing with multiple quantum wells", Invited colloquium, Johns Hopkins University, March 1996

W. S. Rabinovich, "Optically addressed multiple quantum well spatial light modulators", Invited colloquium, Physics Department, University of Maryland, Baltimore County, October 1997.

W. S. Rabinovich, R. Mahon, S. R. Bowman, D. S. Katzer and K. Ikossi-Anastasiou, "Lock-in holography using optically addressed multiple quantum well light modulators", Invited presentation at CLEO 99

W. S. Rabinovich, R. Mahon, S. R. Bowman, D. S. Katzer and K. Ikossi-Anastasiou, "Non destructive evaluation of materials using optically addressed multiple quantum well light modulators", Invited presentation at OSA Annual meeting 1999

W. S. Rabinovich, "Cat's eye modulating retro-reflectors for free space optical communications", DARPA Technical Interchange Meeting on Free Space Optical Communications, Lexington, MA, November 2000

### **Patents**

Steven R. Bowman and William S. Rabinovich. "Holmium Laser Pumped with a Neodymium Laser", accepted by the US Patent Office.

W. S. Rabinovich, S. R. Bowman, D. S. Katzer and C. S. Kyono, "An optically addressed spatial light modulator using an intrinsic semiconductor active material and high resistivity cladding layers" #75,651

W. S. Rabinovich, S. R. Bowman, D. S. Katzer and G. Beadie, "Hybrid electrically-optically addressed multiple quantum well spatial light modulator"

G.C. Gilbreath, S.R. Bowman, W.S. Rabinovich, C.H. Merk, H.E. Senasack, "Modulated Retroreflector Using Multiple Quantum Well Technology", U.S. Patent No. 6,154,299, awarded November, 2000.